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The Internet knowledge (iKnow) measure ☆

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Abstract

Despite increasing development and administration of Internet surveys, tests, and many other applications to be used by employees and the general public, little is known about the knowledge individuals bring to Internet tasks. This research improves our understanding of the concept of Internet knowledge, and provides initial support for the construct validity of a new measure of Internet knowledge with respect to its factor structure, internal consistency reliability, and concurrent validity. From a practical perspective, clearer definition of Internet knowledge and the availability of a reliable measure of such knowledge can advance our understanding of how individuals develop Internet experience through its use and may also inform the process by which web sites and Internet applications are designed.

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"The Internet is an information 'super highway' that connects people, data and other computers." At least that is what one respondent to a survey (described below) said when asked, "What is the Internet?" Rather than offer a definition, another survey respondent commented that the Internet is "a huge distraction of mine." Other responses provided by the three hundred adults who participated in the present investigation included, "The Internet is a database where you can get any data or anything you need,"…"The Internet

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is an intangible concept. It is essentially the ability to communicate and access other computers,'' and ...''What isn't it?''

Although people appear to have various ideas about what the Internet is, little research has informed our understanding as to what knowledge or background experience regarding the Internet is applied when people access and use it. At the same time, research and practice that uses the Internet as a medium to survey, test, influence, or inform individuals has logically assumed that individuals' Internet knowledge may be a factor in their willingness to respond to web-based surveys, solicitations, and scores on web-based assessments (e.g., Barbeite & Weiss, 2004; Foster Thompson, Surface, Martin, & Sanders, 2003; Harris, Van Hoye, & Lievens, 2003; LaRose, Mastro, & Eastin, 2001). It is assumed, for example, that assessment over the Internet may be ''confounded by the novelty of the format'' (Naglieri et al., 2004, p. 155). This suggests that people who are unfamiliar with the Internet may be at some disadvantage during Internet assessment in comparison with people who are more knowledgeable about the Internet or experienced with its use. Yet, what constitutes familiarity with or working knowledge of the Internet is not clear. What does it mean to be an experienced Internet user? How does a person's Internet knowledge relate to his or her beliefs about the Internet, computer experience, or reactions to a task presented via the Internet? Does an individual's familiarity with the Internet affect performance of tasks that require Internet access and use? How quickly does Internet knowledge develop? The first step to answering questions such as these requires a definition of the domain that includes the knowledge, behaviors, and capabilities that form what we understand to mean ''Internet knowledge.'' Then it is possible to construct an internally consistent, construct valid measure of Internet knowledge.

The purpose of this research is to begin to develop an Internet knowledge measure and to describe the potential application of such a measure for practice and research. The following section presents a construct definition of Internet knowledge. It develops hypotheses to explain the relationships between Internet knowledge and other characteristics of Internet users. Then an initial assessment of the validity of a new self-report measure of Internet knowledge is explored, and results of a study utilizing the measure are presented. Implications for research and practice are discussed in the final section.

1. Internet knowledge as a construct

The concept of Internet knowledge refers to a set of individual characteristics or qualities that develop over time and that generalize from one set of tasks or uses involving the Internet to another. Specifically, Internet knowledge is perhaps best defined in terms of what people know about the Internet as well as the various kinds of things people are able to do using the Internet. These two aspects of Internet knowledge have been identified as essential to the most common uses of the Internet (Page & Uncles, 2004). First, familiarity with terms specific to the Internet (e.g., ''browsers,'' and ''cookies'') may be essential to the development of a person's Internet knowledge. This knowledge of terms represents declarative knowledge (Best, 1989) of the Internet. Of course, knowing how to speak the language of the Internet is not the same as knowing how to effectively ''surf'' the Internet and perform other Internet-related tasks. Second, understanding how to perform relevant procedures associated with Internet use is related to procedural knowledge of the Internet (Best, 1989; Page & Uncles, 2004). For example, successful retrieval of information is probably an important accomplishment of those who could be labeled knowledgeable regarding the Internet.

Support for the above definition of Internet knowledge is found in prior research that has incorporated some index of familiarity with the Internet. For example, Sinar, Reynolds, and Paquet (2003, p. 152) included a two-item measure of prior experience with the Internet: "Before this application process, I was familiar with using the Internet" and "I have previously searched or applied for positions using the Internet." It is interesting to note that Sinar et al.'s first item addressed general knowledge of the Internet, and the second item focused on a specific Internet task relevant to their study. Such a combination of general Internet knowledge and specific task-focused use is important to sampling the domain of the Internet knowledge construct with adequate depth and breadth. That is, an adequate measure of the Internet knowledge construct should incorporate declarative knowledge about the Internet across contexts, but also the ability to perform a variety of task associated with Internet use (i.e., procedural knowledge).

The importance of considering both general knowledge and specific experience associated with task performance was evident in a study by Daley, McDermott, McCormack Brown, and Kittleson (2003). These authors observed that "many, if not most, college students are comfortable with computers and have extensive experience in navigating the Internet" (Daley et al., 2003, p. 123), and they initially presumed that this familiarity would be sufficient for students to participate in their web-based survey. However, these researchers noted that the college students in their pilot study had difficulty navigating within and between survey web sites, and careful instructions and web design modifications were needed. An internally consistent and valid measure of Internet knowledge would aid in the construction of instructional sets for Internet users who vary in terms of their prior Internet use.

2. Construct validation of an Internet knowledge measure

Consistent with the overall objectives and procedures associated with construct validation (Ghiselli, Campbell, & Zedeck, 1981), the goal of the present study was to develop an operational measure of the Internet knowledge construct. Construct validity is documented by demonstrating the correspondence between a measure and the domain of characteristics that define the construct under consideration (Schwab, 1980). The following subsections specify the hypotheses that explore the construct validity of the Internet knowledge measure developed in this research. These subsections address the concurrent validity of the measure, and also the anticipated relationship between the measure and two individual differences variables.

Concurrent validity can be evaluated in terms of the correlation between scores on one measure (Internet knowledge, or iKnow) and scores on another measure administered at the same time (Ghiselli et al., 1981). First, a measure of Internet knowledge should be positively related to individual characteristics such as frequency of Internet use or time spent using the Internet. Such individual characteristics have been used as proxy indices of Internet knowledge in prior research. Second, the development of Internet knowledge depends at least in part on nature of Internet use. Two of the most common Internet uses, for example, are e-mail and information searching. Third, it seems logical to anticipate that Internet knowledge would be related to individual difference constructs such as Internet self-efficacy beliefs and computer experience. Overall, four hypotheses are proposed to

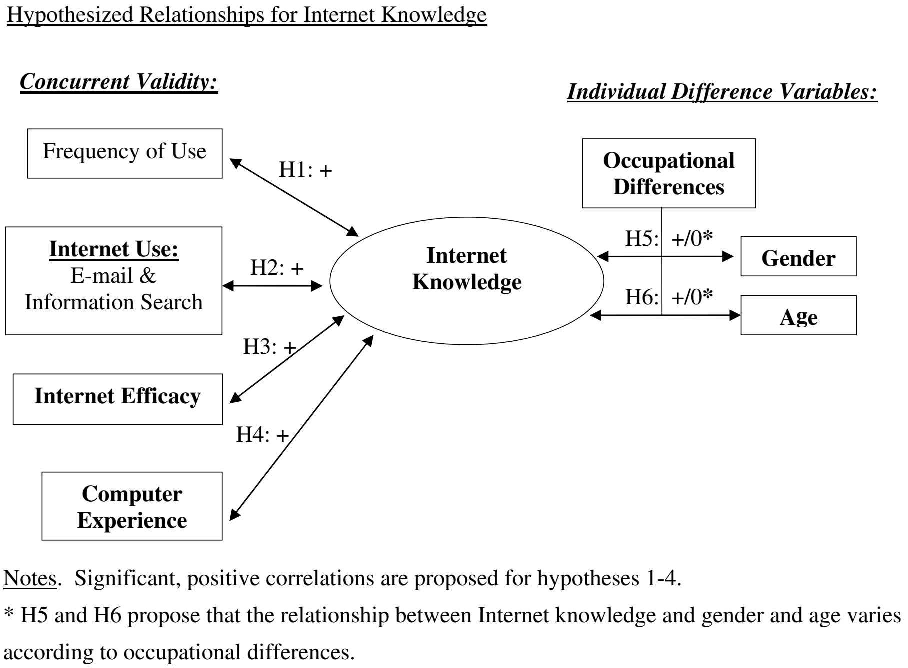
Hypothesized Relationships for Internet Knowledge
Concurrent Validity:
Individual Difference Variables:
Frequency of Use
H1: +
Internet Use:
E-mail &
Information Search
H2: +
Internet Knowledge
H3: +
Internet Efficacy
H4: +
Computer Experience
Occupational Differences
H5: +/0*
Gender
H6: +/0*
Age
Notes. Significant, positive correlations are proposed for hypotheses 1-4.
* H5 and H6 propose that the relationship between Internet knowledge and gender and age varies according to occupational differences.

Fig. 1. Hypothesized relationships for Internet knowledge. *Notes*. Significant, positive correlations are proposed for hypotheses 1–4. *H5 and H6 propose that the relationship between Internet knowledge and gender and age varies according to occupational differences.

define the Internet knowledge construct and to provide evidence of the concurrent validity of the iKnow measure. Two additional hypotheses show how the iKnow measure might relate to two individual differences variables, gender and age. These hypothesized relationships are depicted in Fig. 1.

2.1. Frequency of use

In the past, researchers have attempted to account for variability in Internet knowledge without actually defining a construct. Internet knowledge has been measured in terms of how often or how long a person uses or has used the Internet. For example, some researchers assessed Internet knowledge using a single item that referred to how long a person had been using the Internet (e.g., Eastin & LaRose, 2000; who asked about Internet use from less than one month to more than 24 months). Such a measure of time spent using the Internet is flawed in that both newer users as well as more expert users might spend a considerable amount of time connected to the Internet, but it might take less knowledgeable users longer to find what they are looking for. Although it may be useful to include self-reported estimates of the time spent on-line as a correlate of Internet knowledge, time or frequency of use is not a substitute for the Internet knowledge construct.

Some studies have attempted to account for variability in Internet knowledge by asking questions that combine time spent using the Internet with familiarity regarding specific Internet terms or tasks. For example, Harris et al. (2003, p. 232) measured Internet knowledge in terms of familiarity using a single item with a four-point rating scale: "1 = use it sometimes; not familiar with technical issues (e.g., I do not know what 'cookies' are) to 4 = expert at the Internet (e.g., I can create 'cookies')." This approach implies that familiarity somehow increases over periods of Internet use, although it is not clear how much time might be required in order to become knowledgeable about the Internet. In light of the use of measures of frequency of Internet use over time in prior research, the first hypothesis proposes that Internet knowledge is positively associated with frequency of Internet use.

H1: Frequency of internet use will be positively correlated with internet knowledge

2.2. E-mail and information search

People use the Internet in several different ways and for a variety of reasons. In the process of using the Internet, it seems logical to assume that people develop Internet knowledge as they become more familiar with Internet terms and formats and learn new uses and procedures. Also, although individuals might ask for some help from others on an ad hoc basis, it seems unlikely that most people sign up for formal Internet use classes prior to "logging on." People depend upon the "user-friendly" features of some commercial websites and apply their very basic understanding of the Internet to access the Internet, use a mouse to "click" on things, etc., and this basic knowledge enables even a novice to use the Internet. At the "beginner" end of the continuum along which varying levels of Internet expertise and use may fall, Internet knowledge is low. Internet knowledge increases as individuals use the Internet, learn shortcuts and conventions for its use, and increase the number of different functions they can perform.

The use of e-mail and use of the Internet to search for information may represent the most common and most basic types of Internet use. Such Internet use may serve as a starting point for learning more about the Internet. For example, people may use e-mail to communicate with friends or co-workers, and such use may enhance the development of Internet knowledge. The use of the Internet for communication depends upon the availability and "presence" of others with whom a person can interact via the Internet, however. In short, the fact that someone uses e-mail or other Internet-mediated communication tools does not necessarily define Internet knowledge, but such use may support the development of Internet knowledge.

Searching the web for news, products, or other information is another common use of the Internet. The first time a person chooses to use the Internet to look something up may be similar to the experience of walking into a library or a bookstore, or even a department store for the first time. Or it may be similar to the first time one turns on a television, channel changer in hand. Perhaps the person knows what he or she is looking for, or maybe the person just wants to "look" or to "browse." It is also possible that individuals who have more Internet knowledge might be faster or more efficient in their Internet searching. Such "speed of use," however, may depend on Internet connection speed and hand-eye coordination, and as such is an inadequate proxy for Internet knowledge. Even so, the use of the Internet to search for information is likely to be related to the formation of Internet knowledge, and the rate at which one can maneuver and search is likely to vary among Internet users based at least in part upon levels of Internet knowledge. Like e-mail use, the use of the Internet to search for information and the speed of this searching does not define one's Internet knowledge, but such use should be related to the development of Internet knowledge.

H2: The correlation between use of the internet (for e-mail and for information searching) and internet knowledge will be positive

2.3. Internet self-efficacy beliefs

Self-rated Internet knowledge includes an individual's self-assessment of their current Internet skill, but also of their capability to apply these skills. Support for the notion that Internet knowledge naturally includes perceived capability is found in other research on the experiences of Internet users (Pace, 2003). For example, when using the Internet, "the user's skill or capacity to find whatever he or she is looking for" (Pace, 2003, p. 347) has been reported to be an important element to achieving "flow" in Internet use. A measure of Internet knowledge should not only reflect what an individual knows or does not know or what specific skills they currently possess, but also what Internet users believe they are generally capable of knowing and doing with regard to the Internet.

Perceived capability, however, is not only a reflection of knowledge but also of one's efficacy beliefs. Self-efficacy beliefs are defined as one's belief in the ability to perform a specific task (Bandura, 1977), and these beliefs are likely to predict subsequent engagement in such tasks. For example, perceived computer self-efficacy beliefs have been shown to predict whether or not individuals would use computers (Hill, Smith, & Mann, 1987). Similarly, Internet efficacy beliefs may predict Internet use. In addition, as people make decisions while using the Internet (e.g., whether or not to download a file, install updates, etc.) and gain Internet knowledge, they may be more successful in accomplishing Internet tasks. It is hypothesized that Internet efficacy will be positively related to Internet use and Internet knowledge.

H3: Internet self-efficacy, internet use, and internet knowledge will be positively correlated with each other

2.4. Computer experience

Some prior research has associated Internet knowledge with computer experience or proficiency. For example, one 10-item computer experience scale (Bozionelos, 2004) included three items focused on the use of the Internet or online resources. Another test of computer proficiency included e-mail, the Internet, and information search as subdomains, and three items focused on the Internet (Bradlow, Hoch, & Hutchinson, 2002). In this computer proficiency measure, one item asked respondents to identify the names of web browsers, one item asked respondents to match the correct Internet term to a definition, and a third item asked what an Internet site "knows" about a person who visits the site for the first time (Bradlow et al., 2002, p. 242). Interestingly, this test was developed as measure to be administered via the Internet to Internet users.

Research has suggested that individuals with more Internet experience and/or who spend more hours on-line tend to also have more computer experience (Bradlow et al., 2002). Similarly, individuals who considered themselves "more technology savvy"

(p. 249) may also be more computer proficient. It is not clear from these results, however, that computer experience or proficiency should completely describe Internet knowledge. Indeed, Bradlow et al. (2002) noted that Internet knowledge appeared to be somewhat distinct from computer experience. This point is not surprising, however, since a person with very little computer experience can successfully access and use the Internet. Such a person may use the Internet and become more knowledgeable about Internet terms, but broader computer knowledge and proficiency does not necessarily follow from Internet use. On the other hand, the relationship between computer understanding and experience and Internet knowledge may become more apparent as a person develops computer experience in order to open, organize, and downloaded files or learns to use computer software to develop web pages. As such, computer knowledge and experience should be positively related to Internet knowledge, and it is important to include computer experience in the nomological network surrounding the Internet knowledge construct.

H4: There will be a positive correlation between computer experience and internet knowledge

3. Individual difference variables

3.1. Gender

Considerable research has been done to describe the "digital divide" in terms of access to the Internet among various demographic groups, and also in terms of inequalities between men and women in terms of their computer experience and their representation in computer science and information technology (IT) occupations. Several studies have reported that men tend to have greater computer experience than women (e.g., Igbaria, Parasuraman, & Pavri, 1990; Potosky & Bobko, 1998; Potosky & Bobko, 2004), and since computers are the most common means of accessing the Internet, one might also expect gender differences in Internet knowledge that favor men.

Some studies comparing men's and women's Internet use and their perceptions of Internet usefulness suggest less of a gender gap for Internet use than for computer use and experience. For example, Anandarahan, Simmers, and Igbaria (2000) reported no significant gender differences for Internet use among graduate students, and Zhang (2005) found no significant gender differences in Internet usefulness among 680 telecommunication employees. Jackson, Ervin, Gardner, and Schmitt (2001) found that men used the Web more than women, but that women used e-mail more than men, so that when overall Internet use was considered, gender differences were not significant.

Based upon a survey of a large sample ($N = 3032$) of adults in the US collected 1996, 1998, and 1999, Bimber (2000) reported that gender did not account for any differences in Internet access, but that gender exerted a strong effect on frequency of Internet use. By including full-time employment status in his analysis, Bimber (2000) also observed that men's jobs seemed to contribute more to frequent Internet use than women's jobs. It may be that as socioeconomic, educational, occupational gaps between men and women decline, so will the gender gap related to frequency of Internet use. In terms of Internet use, the National Telecommunications and Information Administration (NTIA) of the US Department of Commerce reported that although men were more likely than women to use the Internet in 1997 (around the same time that Bimber (2000) data were collected), women and men had virtually identical rate of Internet use by August 2000 (US Department of Commerce, NTIA, 2001). Internet use (including e-mail) may be more pervasive throughout American society than other computer use, and anticipated gender-related differences in Internet knowledge may reflect self-selection into academic majors and occupations moreso than differential use of the Internet by men and women. As explained in a report by the NTIA, higher levels of education are correlated with occupations that require greater use of the Internet at work and a person's use of the Internet at work is related to whether or not a person accesses the Internet from home (US Department of Commerce, NTIA, 2001). Particularly relevant is the NTIA report that in 2001 the proportion of women who use the Internet and/or e-mail at work exceeded the share of men who use the Internet at work by a ratio of 44.4–39.3%. However, the NTIA also reported that differences in Internet use at work exist between male-dominated fields (such as engineering or information technology) and female-dominated occupations. As such, hypothesis five proposes that it may be important to consider occupational differences when examining potential gender differences in Internet knowledge:

H5: The correlation between Internet knowledge and gender will be moderated by occupational differences

3.2. Age

Several studies have reported a negative relationship between age and computer experience (e.g., Gist, Schwoerer, & Rosen, 1989; Igbaria et al., 1990), and older individuals tend to access and use the Internet less than younger individuals (Perry, Simpson, NicDomhnaill, & Siegel, 2003). According to NTIA data, people aged 55 and older were least likely to use the Internet for common uses such as playing games, job searching, participating in chat rooms, or online trading (US Department of Commerce, NTIA, 2001). On the other hand, Internet knowledge should increase over time with access and use. Further, it has been suggested that the technology gaps between older and younger individuals may decrease as baby boomers and "information age" generations age (Perry et al., 2003; Russell, 1998). Perhaps older individuals are underrepresented in occupations that require Internet use, specifically IT occupations (DiDio, 1998; Kenedy, 2000). From this, it can be anticipated that individuals who work in occupations that incorporate Internet use will not vary in terms of Internet knowledge based upon age (especially pre-retirement age).

H6: The correlation between Internet knowledge and age will be moderated by occupational differences

4. Method

4.1. Study design and participants

Data were collected from a survey study in which volunteer respondents were recruited primarily from the working adult student population participating in part-time professional master's degree programs at a large university graduate school. However, survey respondents from an undergraduate class of business majors at a separate school and respondents from outside the university system were also recruited. Overall, a targeted sample of 400 adults was recruited for this study, and 300 surveys were returned. This sample sought to include adults who ranged in age as well as background in relation to anticipated computer and Internet use. Respondents included 64 software engineers and 27 information systems professionals, who were likely to have considerable expertise with the Internet, and 154 part-time MBA students; 24 undergraduate business majors; and 30 other survey respondents who were not associated with a university and who did not work in an information technology (IT) or related occupation. Overall, respondents ranged in age from 18 to 71 years ($M = 32.58$, $\mathrm{SD} = 9.75$), 34% of the respondents were female, and 79% were white. Eighty-four percent of the respondents indicated that they used the Internet as part of their jobs, 97% said they owned a computer, and 99% reported having their own e-mail account.

4.2. Measures

4.2.1. Internet knowledge measure development

In order to develop a measure that reflected the proposed definition of the Internet knowledge construct, it was first necessary to understand what comprises the more common uses of the Internet, Internet behaviors, etc., as well as the most appropriate and common language used (i.e., vernacular) when people consider the Internet. In addition to reviewing the research and popular literature, the author interviewed five individuals who varied considerably on their expertise and the frequency with which they used the Internet: an IT director, a webmaster, a retired senior citizen, an attorney, and a homemaker were interviewed. These individuals were asked about their Internet use and what they believed it meant to be good at using the Internet. They were also asked to describe and define the Internet. Careful attention was paid not only to the content of interviewees' responses regarding the Internet, but also to how each individual spoke about the Internet and the terms and phrases used to describe it. With this information, a pool of items was created to reflect the Internet knowledge construct.

4.2.2. Internet knowledge items

Three items developed for the Internet knowledge measure asked respondents to indicate their declarative knowledge regarding a specific Internet term (e.g., "I know what a browser is."). At a more general level, one item included in the measure asked study participants to indicate the extent to which they "understand most computer terms that have to do with the Internet." In addition, several items referred to key Internet terms (e.g., browsers, cookies, html, plug-ins, etc.) when asking respondents to rate their ability to perform a variety of Internet-related tasks related to the term. For example, one such item was "I know how to enable and disable cookies on my computer." Other items included knowing how to download and install software updates from the Internet, to fix problems that may be encountered when accessing the Internet, and to recognize and possibly avoid viruses. One item asked if the respondent helped others who are learning to use the Internet, and it was expected that this item would also be associated with Internet knowledge and self-rated ability.

Internet knowledge items were presented using a six point, Likert-type scale with the following response options: "I don't understand this statement and cannot respond"

(0), strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4), and strongly agree (5). The "I don't understand..." option was included to increase the likelihood of measuring actual knowledge instead of each respondent's ability to guess or to select a response that they did not understand. These items were recoded to "Strongly disagree" which indicated low Internet knowledge, for the purposes of subsequent analysis. The following instructions for responding were provided: "Please respond to each of the following statements by circling the number that most closely reflects your own knowledge and experience regarding the Internet. There are no right or wrong answers, so please answer honestly."

4.2.3. Information search internet use items

Six items were created to assess the use of the Internet to search for information, and two of these items also referenced the speed with which individuals maneuvered around the information presented (e.g., "When using the Internet, I quickly find information that I am looking for"). The internal consistency estimate of these items was $\alpha = .81$. These items are listed in Appendix A.

4.2.4. E-mail internet use items

Five items that focused on the use of the Internet for e-mail were developed for this study. The internal consistency estimate for these items was $\alpha = .84$. These items are listed in Appendix A.

4.2.5. Other measures administered

In addition to the Internet knowledge and Internet use items described above, additional survey items were included in order to address non-Internet computer use and computer games. Two items asked respondents to distinguish between computer use and their Internet access: "I use my computer for many things other than Internet access" and "I don't use the computer for much else besides Internet access." One item referred to whether or not respondents played games that can be accessed via the Internet.

The 12-item Computer Understanding and Experience (CUE) scale (Potosky & Bobko, 1998) and a six-item Internet efficacy measure were also administered. Examples of the Internet efficacy items are "I am certain I can perform Internet tasks well" and "It is just not possible for me to use the Internet at the level of ability I would like" (reverse-scored item). The internal consistency estimate obtained from the current sample was $\alpha = .90$ for the CUE scale and $\alpha = .87$ for the Internet efficacy items.

In addition to age, sex, and ethnicity, the survey asked respondents to indicate how often they used the Internet (never, rarely, a few times each month, once or twice per week, once per day, or several times each day). Respondents were also asked if they owned a computer, if they had their own e-mail account, and if they used the Internet as part of their jobs. The last question on the survey was open ended: "What is the Internet?"

5. Results

5.1. Factor structure

Principal components factor analysis was performed on the Internet knowledge items (see Table 1), and this analysis produced a single factor solution. As a result, the Internet

Table 1
Item descriptions, item-total correlations, and factor loadings for the iKnow measure

Mean	SD	I-T r	Factor loading	Item	Description
3.81	1.21	.81	.80	1	If a computer problem occurs while I am using the Internet, I usually know how to fix the problem
3.24	1.65	.74	.73	2	I know how to create a website
3.67	1.33	.74	.78	3	I know some good ways to avoid computer viruses
3.43	1.50	.71	.68	4	I am familiar with html
3.86	1.49	.78	.70	5	I know how to enable and disable cookies on my computer
4.00	1.36	.70	.70	6	I am able to download a "plug-in" when one is recommended in order to view or access something on the Internet
4.22	1.01	.75	.64	7	I understand most computer terms that have to do with the Internet
3.84	1.15	.72	.66	8	I can usually fix any problems I encounter when using the Internet
3.66	1.29	.66	.63	9	I help others who are learning to use the Internet
3.98	1.32	.70	.57	10	I download and install software updates from the Internet when necessary
3.72	1.38	.63	.58	11	I regularly update my virus protection software
4.08	1.24	.66	.53	12	I can design a nice background and/or signature for the e-mail messages I send
4.63	.86	.59	.50	13	I know what a browser is
4.16	1.25	.64	.47	14	I have changed the settings or preferences on my computer that pertain to my Internet access

knowledge measure was constructed using the fourteen items that comprised it. Examination of the items for this unidimensional scale indicated that this measure reflected both knowledge of Internet terms (i.e., "know what") and self-rated capability (i.e., "know how"). Given the emphasis on knowledge expressed in the items comprising the scale, the scale was nicknamed the "iKnow Scale."

5.2. Internal consistency reliability

The 14-item iKnow scale demonstrated the following characteristics: mean = 54.30, standard deviation = 13.55, median = 58.00, skewness = −.84, kurtosis −.07, and the internal consistency estimate was $\alpha = .94$. Means, standard deviations, and item-total correlations for these 14 items are shown in Table 1.

5.3. Concurrent validity

Table 2 shows the descriptive statistics and intercorrelations between the measures and variables included in the survey. These results suggest that the iKnow measure was significantly and positively correlated with frequency of Internet use ($r = .41$, $p < .001$), as expected from Hypothesis 1. Also with regard to Internet use, the iKnow measure was significantly and positively related to e-mail use ($r = .64$, $p < .001$) and information search

Table 2
Descriptive statistics and intercorrelations

Variable	*n*	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. iKnow	299	54.30	13.55	(.94)											
2. Frequency of Internet use[a]	289	5.86	.50	.41***	–										
3. E-mail use	299	23.17	3.10	.64***	.57***	(.84)									
4. Search use	298	25.68	4.37	.66***	.50***	.65***	(.81)								
5. CUE	297	47.98	8.69	.86***	.44***	.58***	.59***	(.90)							
6. Internet efficacy	297	24.68	4.93	.72***	.46***	.63***	.68***	.70***	(.87)						
7. Computer use	300	8.79	1.68	.32***	.23***	.30***	.28***	.37***	.39***	–					
8. Games	300	2.64	1.60	.18**	.08	.12*	.25***	.13*	.14*	.05	–				
9. Age	283	32.58	9.75	−.27***	−.17**	−.33***	−.33***	−.17**	−.27***	−.05	−.32***	–			
10. Sex[b]	292	0.66	.48	.24***	.08	.11	.02	.22***	.04	−.06	.04	−.03	–		
11. Computer ownership[c]	291	0.97	.17	.19***	.23***	.23***	.16**	.17**	.13*	−.06	.07	−.12*	.12*	–	
12. E-mail account[c]	291	0.99	.12	.26***	.44***	.46***	.18**	.25***	.24***	.04	−.01	−.29***	.10	.32***	–
13. Use in job	280	0.84	.37	.25***	.37***	.28***	.25***	.32***	.29***	.24***	.07	.13*	.07	−.02	.11

Notes. Internal consistency estimates (alphas) are shown in the diagonal. Sample size (*n*) varies among the variables listed above due to missing responses within the 300 completed surveys returned.

***$p < .001$, **$p < .01$, *$p < .05$.

[a] Frequency of Internet use ranged from 6 = several times each day to 1 = never.

[b] Sex was coded 1 = male, 0 = female.

[c] "Do you own a computer?" and "Do you have your own e-mail account?" questions were coded 1 = Yes 0 = No.

use ($r = .66$, $p < .001$), as suggested by Hypothesis 2. Note that the iKnow measure was also positively related to computer ownership, having an e-mail account, and using the Internet at one's job (see Table 2).

As suggested in Hypotheses 3 and 4, the iKnow measure was positively associated with the computer understanding and experience (CUE) measure ($r = .86$, $p < .001$) and with Internet self-efficacy beliefs ($r = .72$, $p < .001$). These correlations are, in fact, very high, and common method variance may explain a portion of the relationship indicated. Overall, results pertaining to hypotheses 1–4 offer support for the concurrent validity of the iKnow measure.

5.4. Individual differences variables

In terms of gender differences in Internet knowledge, men reported significantly greater Internet knowledge ($r = .24$, $p < .001$) as well as computer understanding and experience ($r = .22$, $p < .001$). This was observed across all subgroups studied, with one exception: for the 149 MBA students who reported their sex, iKnow scale responses were unrelated to sex ($r = -.05$, NS). In contrast, among the 24 (63% male) undergraduate business majors, iKnow scale responses correlated $r = .67$ ($p < .001$) with being male. Men were slightly more likely to report owning their own computer ($r = .12$, $p < .05$). There was no significant relationship between sex and Internet self-efficacy beliefs, frequency of Internet use, computer use, having an e-mail account, or use of the Internet on the job. What is interesting about these results is that while gender differences in Internet use were not found, gender differences in Internet knowledge may exist. This is consistent with Jackson et al. (2001) observation that men and women use the Internet equally often, but in different ways.

In order to further test Hypothesis 5, the iKnow scale was regressed on occupation code and sex. Specifically, occupational groups were recoded as 1 = high technology (i.e., likely to include Internet work) and 0 = low information technology-oriented occupations. Undergraduate students in the sample were excluded from this analysis. The overall model tested was significant ($R^2 = .09$, $F = 13.39$, $p < .001$), and regression weights for both occupation ($b_1 = 6.41$, $p < .001$) and sex ($b_2 = 4.75$, $p < .01$) were significant. These results contradict Hypothesis 5 and suggest that sex was a significant correlate of Internet knowl-

Table 3
Descriptive statistics by sample subgroups for measures administered

Group	n	Sex		Age		iKnow Scale		CUE Scale		Internet efficacy	
		Men	Women	Mean	SD	Mean	SD	Mean	SD	Mean	SD
SENG	64	52	10	31.90	7.94	76.06	8.71	53.30	4.98	26.63	3.63
MIS	27	16	11	34.12	10.90	68.70	15.51	49.12	6.93	25.31	3.78
MBA	154	95	54	32.90	7.87	68.33	13.09	48.06	7.30	25.20	4.46
UG-BUS	24	15	9	23.46	4.24	56.63	16.06	42.33	8.70	20.71	4.82
GENERAL	30	14	16	38.40	16.44	56.07	21.78	39.77	13.31	20.53	6.61

Note. SENG, software engineers; ISP, information systems professionals; MBA, master of business administration students; UG-BUS, undergraduate business majors; GENERAL, respondents not associated with a university.

edge even after partialling out potential effects associated with the broad IT/non-IT occupational classification. In considering this result alongside the lack of gender differences in Internet knowledge among MBA students, support Hypothesis 5 is inconclusive.

Hypothesis 6 focused on potential age differences associated with Internet knowledge, and proposed that occupational differences would mitigate the correlation between age and Internet knowledge. A breakdown of mean age, iKnow, CUE, and Internet efficacy scores by occupational group is shown in Table 3. In terms of the various occupational groups studied, the iKnow measure clearly distinguished between those likely to have considerable expertise regarding the Internet and non-IT professionals. In the sample surveyed, software engineers exhibited the greatest iKnow results, on average; undergraduate business majors and "general" respondents (not associated with a university) reported the lowest iKnow scores. These results support the ability of the iKnow measure to discriminate among occupational groups of Internet users that should have different degrees of knowledge and experience regarding the Internet.

Hypothesis 6 focused on the relationship between age and Internet knowledge, but with the intention of controlling for the potential effects of occupational differences in this relationship. Age was significantly, negatively related to the iKnow scale overall ($r = -27$, $p < .001$). In the overall sample, age was negatively correlated with Internet self-efficacy ($r = -.27$, $p < .001$) and computer understanding and experience ($r = -.17$, $p < .01$). Age was negatively correlated with frequency of Internet use ($r = -.17$, $p < .01$) and to owning an e-mail account ($r = -30$, $p < .001$), but positively correlated with the use of the Internet as part of one's job ($r = .13$, $p < .05$). When Internet knowledge was regressed on the high/low IT occupational variable used to examine Hypothesis 5 (excluding undergraduates, see above) and age, the overall regression model was supported ($R^2 = .21$, $F = 33.39$, $p < .001$), and the regression weights for each variable were significant (Occupation, $b_1 = 7.09$, $p < .001$; Age, $b_2 = -.50$, $p < .001$). When Internet knowledge was regressed on age for each occupational group including undergraduates, however, age was not related to Internet knowledge for IT professionals or business major undergraduates. The fact that the undergraduate group ranged in age from 21 to 40 with a mean = 24 years (SD = 4 years) may explain the lack of relationship between Internet knowledge and age observed for this group. However, the range in age was greater for IT professionals (mean = 34, SD = 11 years), and the correlation between age and the iKnow scale was not significant for this group ($r = .01$, NS, mean age = 34, SD = 10.90). Overall, results of these analyses suggest that although age was negatively related to Internet knowledge, this seems to be true for older groups, and may be tempered somewhat by individuals' occupations. Support for hypothesis 6 is moderate.

6. Discussion and conclusion

The goal of this research was to define the Internet ability construct and to develop a suitable, self-rated measure of this construct. Internet knowledge was defined as a construct that included familiarity with terms, Internet use, and self-assessed capability. Results of principal components factor analysis of items administered to 300 adults suggested that the items represented a unidimensional factor. The 14 items that formed this factor were used to construct the iKnow scale, which provides an internally consistent measure of the Internet knowledge construct.

Support for the concurrent validity of the iKnow measure was also provided in this study. Internet knowledge was positively correlated with frequency of Internet use, Internet use for e-mail and for information searching, computer experience, and Internet efficacy beliefs. In terms of individual difference variables examined, Internet knowledge seemed to vary according to gender and age. Internet knowledge scores were significantly correlated with gender, such that scores were higher for men, and were significantly negatively correlated with age, such that older respondents had lower Internet knowledge scores than younger respondents. Even after taking occupational differences (in terms of whether or not a respondent worked in an information technology field) into account, these gender and age correlates were significant. When different occupational subgroups in this sample were considered, gender differences in Internet knowledge were not consistently observed. Although "general" respondents (who were not affiliated with a university) as well as undergraduate business students showed a bias in favor of men regarding Internet knowledge, the correlation between Internet knowledge and gender for MBA students and engineering master's degree students was not significant. Given the small cell sizes for men versus women in the occupational subgroups included in this study, caution is warranted before generalizing these findings within various occupational subgroups. The negative relationship between Internet knowledge and age may be tempered by occupational considerations, however, especially for IT professionals. In younger groups (e.g., college undergraduates), age was not significantly correlated with iKnow scores, but among more mature groups, age was not significantly correlated with iKnow scores among IT professionals (e.g., software engineers and information systems professionals). Future research might consider occupational classifications and IT-related work in further analyzing the relationship between age and Internet knowledge.

The iKnow measure clearly identified groups of respondents likely to possess high levels of expertise regarding the Internet. However, perhaps one of the most appealing aspects about the items used to create the iKnow scale is that the items were carefully worded so as to identify inexperienced users as well. That is, the measure produced adequate variance in responses so as to provide a meaningful, general measure of Internet knowledge. Overall, the sample used in this study resembled the sample of adults US population that is frequently targeted by researchers and practitioners for Internet-administered surveys and assessments as well as for other Internet information exchanges. Future validation research is needed, however, to determine the measurement properties of the iKnow scale in other samples.

Although this research represents a promising beginning for a new, potentially useful measure of Internet knowledge, the present study had some important limitations that should be acknowledged. First, although the iKnow scale was positively associated with the computer understanding and experience (CUE) scale and the Internet self-efficacy beliefs measure, the correlations between these measures were perhaps too high. This may be due to the single survey study design and the similar item formats for these measures. For most applications of the iKnow measure, this confound may not be problematic. However, where self-efficacy and declarative Internet knowledge need to be precisely discerned, an Internet proficiency test may be preferable. Future study is needed to distinguish between Internet knowledge, computer experience, and self-efficacy beliefs.

Related to this concern is the need to investigate the discriminant validity of the iKnow measure. That is, another limitation of the present investigation was its focus only on concurrent validity, which is only part of the establishment of construct validity. Construct validity is also established by defining the relationships between a measure of one theoretical construct and measures of different theoretical constructs that fall within the nomological network of the construct (Chronbach & Meehl, 1955).

In order to further demonstrate construct validity, Carretta and Ree (2001) recommended examining new measures in relation to an accepted measure of a construct. One interesting new proficiency measure of Internet knowledge, which was not available at the time this study was conducted, is an instrument developed by Page and Uncles (2004) to measure consumer knowledge content of the world wide web. These authors developed a typology for Web knowledge (i.e., two types of knowledge across two levels of expertise) and used it to construct scales to measure declarative and procedural knowledge, which were further broken out into common ("general") and specialized ("expert" or "skilled") types. The goal in this research was to measure knowledge associated with the degree to which Internet users could modify the form and content of web information, and intentionally did not address the broader nomological network for the Internet knowledge construct identified in the present study. Page and Uncles (2004) offer 38 multiple choice and true-false items (across the four separate scales) to test users' knowledge of the web. The "test" format and item-wording of this instrument may present a challenge to some survey groups, especially if they do not already consider themselves to have much Internet knowledge. Also, although this measure may be advantageous when discriminating between individuals on the basis of Internet knowledge and expertise, it is not clear how this knowledge content relates to use of the Internet for communication or information, computer experience, or self-efficacy beliefs. In future validation research, however, it will be useful to administer both the iKnow scale and Page and Uncles' measure in order to further determine concurrent validity within the nomological net of Internet knowledge.

Despite the limitations and the need for additional research noted above, the iKnow measure offers a potentially useful tool for assessing Internet knowledge in adult samples. Future research might also explore the predictive validity of the iKnow measure, identify additional correlates, and further develop the nomological net associated with the iKnow construct. Rather than depend upon proxy measures based upon hours or frequency of use or how long a person has used the Internet, or one or two items to assess general or specific Internet knowledge, this new measure provides a means of determining whether a person is generally familiar with Internet terms, is able to perform common tasks associated with Internet use, and is able to solve problems that may be encountered during Internet use. The measure presented has the potential to identify individuals who have developed some expertise regarding the Internet. It is not a proficiency test, but rather a general assessment of knowledge and capability regarding the Internet.

Information obtained from the administration of the iKnow measure may increase our understanding of how Internet ability develops or increases over time. Such information may be useful not only to researchers who wish to use the Internet to survey groups of people or to administer other assessment tools, but also to practitioners who want to better understand the level of knowledge that focal groups of consumers, employees, students, and other potential Internet users possess and bring to Internet tasks. All Internet users may not be able to articulate a precise definition of the Internet, but people use the Internet nonetheless. The iKnow measure offers the opportunity to determine what knowledge people bring to their Internet use.

Appendix A. Internet use items administered

Information search internet use items:

1. When using the Internet, I quickly find information that I am looking for.
2. I'm usually successful at finding what I am looking for when searching the Internet.
3. I can "surf the web" quickly.
4. I get up-to-date information (e.g., news, stock quotes, sports, weather) from the Internet.
5. I have searched through retail catalogs available on the Internet.
6. I often click on links to go to new web pages when using the Internet.

E-mail internet use items:

1. I can usually recognize and avoid "spam" e-mail messages. a
2. I know how to upload and send files (attachments) with my e-mail messages.
3. I can open and look at photos or other e-mail attachments.
4. I use the Internet to communicate with other people.
5. I regularly check my e-mail account for messages.

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